DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
COMMONWEALTH OF MASSACHUSETTS, WATER RESOURCES COMMISSION

HYDROLOGIC INVESTIGATIONS
ATLAS HA-554 (SHEET 2 OF 3)

GROUND WATER

AVAILABILITY

WATER-BEARING FORMATIONS OF THE CHARLES RIVER BASIN

The principal water-bearing formations or aquifers in the Charles River basin are the sand and gravel of glacial origin and the bedrock that underlies the basin.

The sand and gravel, laid down in many scattered deposits by water flowing from the glacier as it melted, forms the most important aquifer. Only the sand and gravel is capable of yielding the hundreds of gallons of water per minute that is normally expected of town supply wells.

Town-supply wells in the sand and gravel aquifer range from 10 to 24 inches (25 to 60 cm) in diameter and have 10 to 20 feet (3 to 6.1 m) of screen. Water-saturated thickness of the sand and gravel aquifer at sites of wells designed for large capacity averages about 50 feet (15.2 m) and ranges from 20 to 80 feet (6.1 to 24 m). The capacity of such wells ranges from 100 to 1,500 gal/min or 6 to 95 l/s, and averages around 500 gal/min (3.2 l/s).

The specific capacity of a well (yield in gallons per minute per foot of drawdown of water level) is a good indicator of the water-yielding capacity of a well and the formation it taps. Specific capacities of gravel-packed wells in the sand and gravel aquifer range from 10 to 275 gal/min (2 to 57 l/s) and average about 40 gal/min (8 l/s) per foot (metre) of drawdown.

The bedrock that underlies the Charles River basin will provide at almost every point the few gallons of water per minute adequate for home, farm, and minor industrial needs. The water occurs in cracks and crevices in the bedrock, which is mainly granitic and metamorphic.

Almost all the wells drilled into bedrock are for domestic supplies. The common domestic well is 6 to 8 inches (15 to 20 cm) in diameter and deep enough, 50 to 300 feet (15 to 90 m), to intercept enough crevices for small yields. Yields reported for such wells are mostly between 1 and 5 gal/min (0.06 to 0.3 l/s).

Larger yields, as much as 50 gal/min (3 l/s), are reported for some bedrock wells. The larger yields result from intercepting larger or more numerous crevices and drilling in lowlands, rather than the less favorable higher ground. Wells 10 to 12 inches (25 to 30 cm) in diameter drilled in lowlands can probably yield a few tens of gallons per minute.

SELECTED REFERENCES

Brown, Eugene, Skougstad, M. W., and Fishman, M. J., 1970, Methods for collection and analysis of water samples for dissolved minerals and gases: U.S. Geol. Survey Techniques Water-Resources Inv., book 5, ch. A1, 160 p.

Camp, Dresser, and McKee, consulting engineers, 1967, Inventory of water and sewage facilities (Eastern Massachusetts Regional Planning Project), prepared for the Metropolitan Area Planning Council, Department of Commerce and Development, 214 p.

Chute, N. E., 1966, Geology of the Norwood quadrangle, Norfolk and Suffolk Counties, Massachusetts: U.S. Geol. Survey Bull. 1163-B, 78 p.

Commonwealth of Massachusetts, 1939, Special report of the Metropolitan District Commission and the Department of Public Health relative to sewage pollution of the Charles River: Mass. House Doc. No. 1961.

Cushman, E. V., Allen, W. B., and Pree, H. L., Jr., 1953, Geologic factors affecting the yield of rock wells in southern New England: New England Water Works Assoc. Jour., v. 67, no. 2, p. 77–95.

Hem, J. D., 1970, Study and interpretation of the chemical characteristics of natural water, 2d ed.: U.S. Geol. Survey Water-Supply Paper 1473, 363 p.

Hodges, A. L., Jr., 1968, Drilling for water in New England: New England Water Works Assoc. Jour., v. 82, no. 4, p. 287–315.

Jobin, W. R., and Ferrulo, A. F., 1971, Report on the Charles River: Div. of Water Pollution Control, Mass. Water Resources Comm., 48 p.

Koteff, Carl, 1964, Surficial geology of the Concord quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-331.

LaForge, Lawrence, 1932, Geology of the Boston area, Massachusetts: U.S. Geol. Survey Bull. 839, 105 p.

Rainwater, F. H., and Thatcher, L. L., 1960, Methods for collection and analysis of water samples: U.S. Geol. Survey Water-Supply Paper 1454, 301 p.

Stewart, R. K., 1968, Biological aspects of water quality, Charles River and Boston Harbor, Massachusetts, July–August 1967: U.S. Dept. of Interior, Federal Water Pollution Control Admin., Cincinnati, Ohio, 39 p.

U.S. Public Health Service, 1962 (revision), Public Health Service drinking water standards: U.S. Dept. Health, Education and Welfare, Public Health Service, Pub. no. 956, 61 p.

TABLE 3.—WATER SUPPLIES OF THE CHARLES RIVER BASIN ABOVE MOODY STREET IN WALTHAM[1]

Town, City, or Institution	Source of water	Capacity of system (M gal/d)[2]	1970 Pumpage (Mgal) Daily average[3]	Total[3]	Charles River basin[4]
Bellingham	Wells	2.2	.850	310	118
Dedham	Wells	7.7	3.787	1382	925
Dover	Private wells	—	[5].198	[5]72	60
Franklin	Wells	2.4	1.474	538	490
Holliston	Wells	1.9	.879	321	321
Lincoln	Sandy Pond	.4	.130	47	29
	Wells	.7	.303	116	71
Medfield	Wells	2.3	.714	261	204
Medfield State Hospital	Wells		.213	78	78
Medway	Wells	1.8	.660	241	241
Milford	Echo Lake and Charles River		1.208	441	392
	Wells		.518	189	168
Millis	Wells	1.0	.638	233	233
Natick	Wells	9.2	6.390	2330	816
Needham	MDC		1.039	379	379
	Wells	3.4	2.410	880	880
Newton	MDC		11.617	4240	1700
Norfolk	Wells		.065	24	24
Massachusetts Correctional Institution and Prison	Wells		.518	189	189
State Hospital	Wells		.022	8	8
Sherborn	Private Wells		[5].165	[5]60	47
Wellesley	Wells	7.5	3.375	1233	1233
Wellesley College	Wells		.278	102	102
Weston	Wells	2.1	.300	110	100
	MDC		.718	262	238
Westwood	Wells		2.588	945	264
Wrentham	Wells	2.0	.539	197	77
Wrentham State School	Wells		.457	167	167

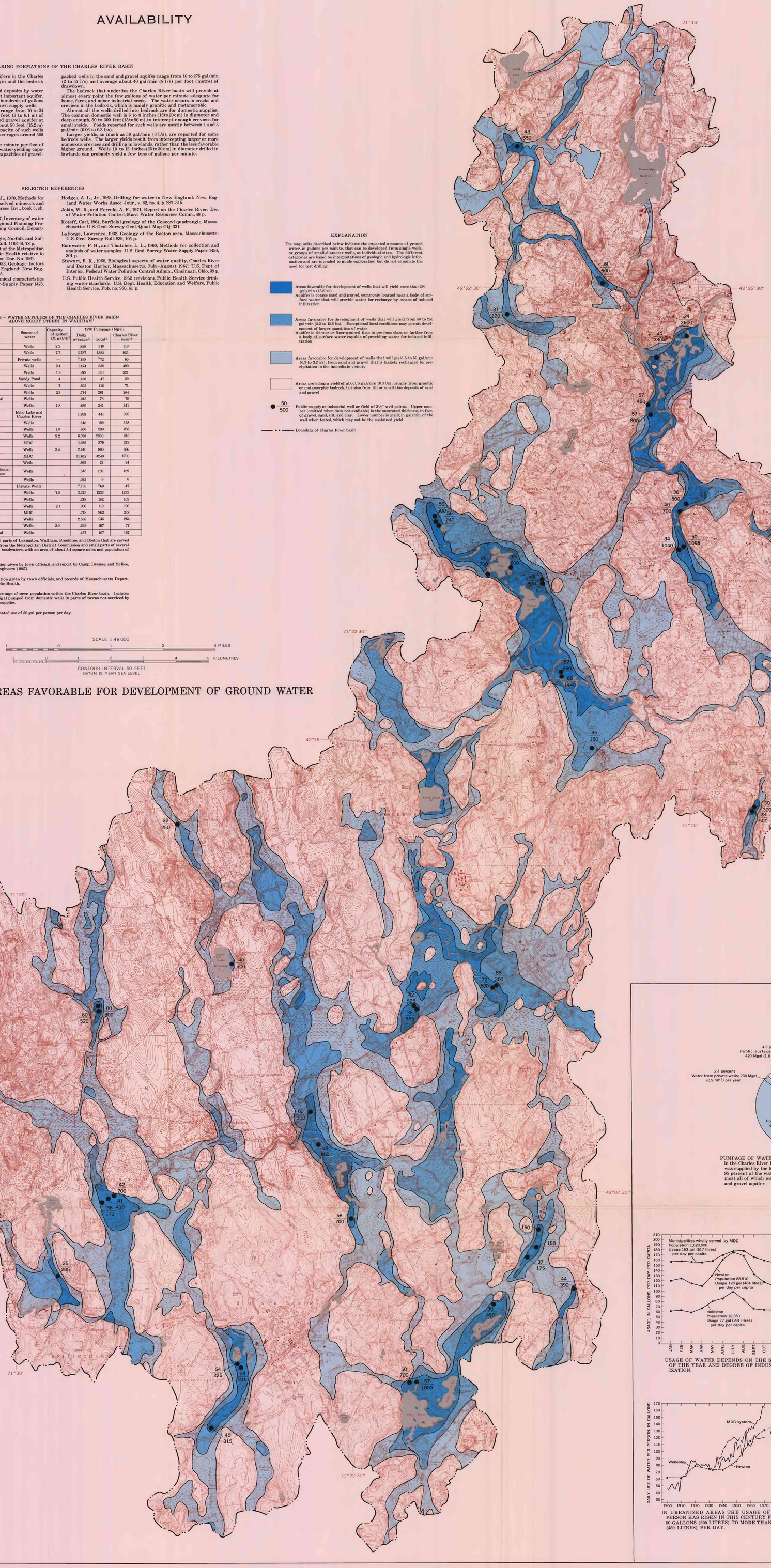
[1] Excludes small parts of Lexington, Waltham, Brookline, and Boston that are served with water from the Metropolitan District Commission and small parts of several towns in the headwaters, with an area of about 5.4 square miles and population of about 2,400.

[2] From information given by town officials, and report by Camp, Dresser, and McKee, consulting engineers (1967).

[3] From information given by town officials, and records of Massachusetts Department of Public Health.

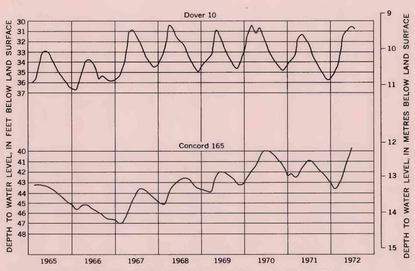
[4] Based on percentage of town population within the Charles River basin. Includes about 225 Mgal pumped from domestic wells in parts of towns not serviced by town water supplies.

[5] Based on estimated use of 50 gal per person per day.



MAP SHOWING AREAS FAVORABLE FOR DEVELOPMENT OF GROUND WATER

RECHARGE OF GROUND-WATER BODIES



THE SAND AND GRAVEL AQUIFER IS A STORAGE RESERVOIR.—In the vicinity of a representative observation well such as Dover 10, the ground-water level rises and falls about 4 feet (122 cm) each year. This shows that there is an increase of about 10 inches (25 cm) of water during the period of recharge from late autumn through early spring, assuming conservatively that the sand and gravel has 20 percent porosity. This amounts to 260,000 gal/acre (2,430 m^3/ha). These same quantities are discharged through seepage in summer and autumn, helping to maintain streamflow during this drier part of the year.

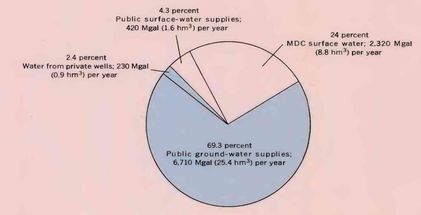
The aquifer also functions as an equalizing reservoir over periods of years. Annual low-water level in the vicinity of the well Dover 10 rose 2 feet (61 cm) from 1966–70, reflecting an increase of 5 inches (12.2 cm) of water, or 130,000 gal/acre (1,215 m^3/ha). About this amount of water would be released from storage and discharged during a series of dry years, such as 1963 through 1966.

Under natural conditions ground water moves through the sand and gravel toward the stream

Pumping a well lowers the ground-water level so that water is induced to move from the stream into the sand and gravel aquifer

NEARBY STREAMS ARE THE SOURCE OF MUCH OF THE WATER PUMPED BY HIGH-CAPACITY WELLS.—A well that pumps hundreds of gallons of water per minute year round discharges more water than the local recharge to the aquifer from precipitation. Some of the water pumped is induced to recharge the aquifer from a nearby stream or other body of surface water. In some places a large fraction of the water pumped by town wells is surface water thus induced.

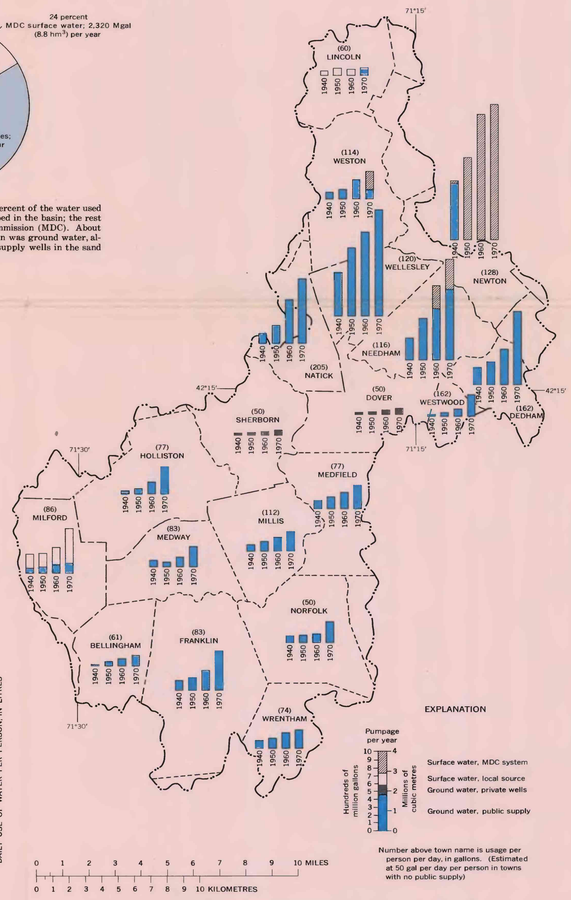
USAGE



PUMPAGE OF WATER IN 1970.—About 75 percent of the water used in the Charles River basin in 1970 was developed in the basin; the rest was supplied by the Metropolitan District Commission (MDC). About 95 percent of the water developed in the basin was ground water, almost all of which was pumped from public-supply wells in the sand and gravel aquifer.

USAGE OF WATER DEPENDS ON THE SEASON OF THE YEAR AND DEGREE OF INDUSTRIALIZATION.

IN URBANIZED AREAS THE USAGE OF WATER PER PERSON HAS RISEN IN THIS CENTURY FROM AROUND 50 GALLONS (200 LITRES) TO MORE THAN 120 GALLONS (450 LITRES) PER DAY.



PUMPAGE OF SURFACE WATER, GROUND WATER, AND WATER SUPPLIED BY THE METROPOLITAN DISTRICT COMMISSION HAS INCREASED CONSISTENTLY IN TOWNS AND CITIES FROM 1940 TO 1970.

WATER RESOURCES OF THE CHARLES RIVER BASIN, MASSACHUSETTS

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